

An annotated checklist of Coccinellidae with four new records from Pakistan (Coleoptera, Coccinellidae)

Muhammad Ali^{1,2}, Khalil Ahmed², Shaukat Ali³, Ghulam Raza¹, Ishtiaq Hussain⁴, Maisoor Ahmed Nafees², Syed Ishtiaq Anjum⁵

1 Department of Biological Sciences, University of Baltistan, Skardu, Gilgit-Baltistan, Pakistan **2** Department of Biological Sciences, Karakoram International University, Gilgit, Gilgit-Baltistan, Pakistan **3** Department of Environmental Science, Karakoram International University, Gilgit, Gilgit-Baltistan, Pakistan **4** Department of Agriculture, District Kharmang, Gilgit-Baltistan, Pakistan **5** Department of Zoology, Kohat University of Science and Technology, Kohat, Khyber Pakhtunkhwa, Pakistan

Corresponding author: Muhammad Ali (muhammad.ali@uobs.edu.pk; ali_zoology@yahoo.com)

Academic editor: M. Thomas | Received 27 November 2018 | Accepted 17 April 2018 | Published 6 December 2018

<http://zoobank.org/44ED6C38-469D-4789-87E6-4216294D08A4>

Citation: Ali M, Ahmed K, Ali S, Raza G, Hussain I, Nafees MA, Anjum SI (2018) An annotated checklist of Coccinellidae with four new records from Pakistan (Coleoptera, Coccinellidae). ZooKeys 803: 93–120. <https://doi.org/10.3897/zookeys.803.22543>

Abstract

Some new ladybird (Coleoptera: Coccinellidae) records collected during the last four years across Sindh are reported. A first preliminary checklist of ladybirds from Sindh is presented, consisting of one subfamily, ten tribes, 21 genera, and 29 species including four new records, namely *Bulaea lichatschovii* (Hummel), *Exochomus pubescens* Küster, *Scymnus (Pullus) latemaculatus* Motschulsky, *Scymnus (Pullus) syriacus* Marseul, and four varieties of the species *Cheilomenes sexmaculatus* (Fabricius).

Keywords

aphid, Chilocorinae, Coccidulinae, Coccinellinae, mealybug, predatory, Coccinellinae, Scymninae

Introduction

According to the most recent classification, the family Coccinellidae comprises two subfamilies: Microweiseinae Leng, 1920 and Coccinellinae Latreille, 1807 (sensu Slipinski 2007) based on phylogenetic results (Seago et al. 2011). These changes impact the status of various traditionally recognized tribes and subfamilies, as the only sub-

families now recognized are Microweiseinae and Coccinellinae (Canepari et al. 2016). Microweiseinae comprises three tribes: Carinodulini, Microweiseini, and Serangiini whereas Coccinellinae consists of only two tribes: Coccinellini and Chilocorini (Robertson et al. 2015).

Worldwide, nearly 6000 species spanning nearly 360 genera are known. Approximately 90 % of the species are predators of aphids, coccids, psyllids, aleyrodids, chrysomelid larvae, and mites, the remainder being herbivorous or mycetophagous (Inayatullah 1984, Majerus 1994, Obrycki and Kring 1998, Iperti and Bertand 2001, Vandenberg 2002, Hodek 2012). The Coccinellidae are an important group of beetles from both an economic standpoint in their use as biological control agents and in their diversity and adaptation to a number of differing habitats (Michels 1987).

From Pakistan, Ahmad and Ghani (1966, 1968, 1970, 1973), Inayatullah and Sidiqi (1978, 1979, 1980), and Ali et al. (2012) worked on different species of the family Coccinellidae; Iablokoff-Khnzorian (1986) described a new species *Adalia puetzi* from Pakistan; Hashmi and Tashfeen (1992) studied the coccinellids housed in different institutions of Pakistan and reported 162 species, identifying the coccinellids deposited in the Natural History Museum, London, but with wrong synonymies. The present authors tried to trace this valuable collection of coccinellids in the present institutions in Karachi and other cities of Pakistan but found very few coccinellids. The authors also tried to correct the wrong synonymies and wrong identifications mentioned in the above-mentioned paper with the help of checklists and taxonomic papers available. Irshad (2001) listed 71 species of coccinellids in Pakistan; Rafi et al. (2005) gave a brief external morphology of predatory coccinellids of northern parts of Pakistan with special reference to their hosts, prey and localities, and listed 37 genera and 75 species belonging to different tribes of subfamilies Chilocorinae, Coccidulinae, Coccinellinae, Scymninae, and Sticholotidinae. All listed species are very common in Pakistan and represent a much less complete inventory than that of Hashmi and Tashfeen (1992). Otherwise, the description of genitalia was totally absent. Ali et al. (2012, 2013, 2014, 2015) conducted a systematic study from Sindh Province for the first time. They listed 29 coccinellids with four new records and four varieties of *Cheilomenes sexmaculatus*.

According to Ghouri 1960, Kazmi 1980, Hashmi et al. (1983), Ali and Munir 1984, Ghani 1985, Inayatullah 1984, Mohyuddin and Mahmood 1993, Buriro 1996, Jan et al. 2003, Aslam et al. 2004, Abbas et al. 2007, Solangi et al. 2007, Massod et al. 2008, Rafiq et al. 2008, Arif et al. 2009, Mari and Lohar 2010, Iqbal et al. 2008, Iqbal et al. 2011, and Masood 2011, the following viz., *Schizaphis graminum* (Rondani), *Sitobion avenae* (Fabricius), *Aphis gossypii* Glover, *Aphis fabae* Scopoli, *Aphis nerii* Boyer de Fonscolombe, *Aphis craccivora* (Koch) *Rhopalosiphum maidis* (Fitch), *Therioaphis trifolii* (Monell), *Hysteroneura setariae* (Thomas), *Lipaphis erysimi* (Kaltenbach), *Brevicoryne brassicae* (Linnaeus), *Myzus persicae* (Sulzer), and *Hyadaphis coriantri* (Das) (Homoptera: Aphididae); *Amritodus atkinsoni* (Lethierry)), *Amrasca biguttula* (Ishida), *Empoasca lybica* (Bergevin and Zanon) (Homoptera: Cicadellidae); *Bemisia tabaci* (Gennadius), *Aleurolobus barodensis* (Maskell), *Dialeurodes citri*

(Ashmead) and *Aleurocanthus husaini* Corbett (Homoptera: Aleyrodidae); *Brevipalpus lewisi* McGregor (Acarina: Tenuipalpidae), *Eutetranychus orientalis* (Klein), and *Tetranychus atlanticus* McG. (Acarina: Tetranychidae) are common pests of wheat, cotton, sugarcane, mango, mustard, vegetables, and fruits in Pakistan. Other works related with the taxonomy, morphology, diversity, distribution and ecology of different coccinellids include Rahman (1940), Ahmad (1969), Irshad (2001b), Khan et al. (2006), Rahatullah et al. (2010, 2011, 2012); Ali et al. (2012); Abbas et al. (2013), and Ashfaque et al. (2013). Ali (2012, 2013, 2014, 2015) was the first to report 29 coccinellid species from Sindh with a brief study on the taxonomy of the family Coccinellidae and their role in the field of biological control of important agricultural crop pests such as aphids, mealybugs, scale insects, jassids, and whiteflies.

The coccinellid fauna of Sindh, Pakistan is insufficiently known, and no checklist exists. The goal of this paper is to contribute to the knowledge of diversity and distribution of ladybirds in Sindh as well as to present the first preliminary checklist of the species recorded previously in the territory of Sindh.

Materials and methods

Ladybird records presented in this paper were collected, identified, and confirmed during the last four years by the authors following the checklists, descriptions, and keys given by Chapin and Ahmad (1966), Pang and Gordon (1986), Poorani (2004), and Rafi et al. (2005), and with the help of the following website: NBAIR (2009). Ladybirds were also identified and confirmed by Dr. Claudio Canepari (Societa Entomologica Italiana), an authority on the family Coccinellidae. Specimens were collected during field trips conducted in different parts of Sindh Province, and in reality represent random findings instead of systematic collecting. Beetles were collected in standard ways, including manual collecting, net sweeping, and using light traps. The terminologies for various taxonomic structures including genitalia and procedures used by Inayatullah and Siddiqui (1978) and Gordon (1985) were generally followed. The taxonomic structures, especially male and female genitalia, were preserved after illustration in microvials with glycerine and pinned with specimens.

Results

The coccinellids present in this checklist are classified on the basis of the new classification given by Seago et al. 2011, Robertson et al. 2015, and Canepari 2016. According to this classification all the coccinellids of the Sindh Province belong to the subfamily Coccinellinae only. It includes nine species of the tribe Coccinellini, one species of the Psylloborini, one species of the tribe Bulaeini, five species of the Chilocorini, one species of the Tribe Noviini Mulsant, one species from Tribe Hyperaspini, one species from the

Tribe Stethorini, six species of Scymnini, one species of the Tribe Shirozuellini, and three species of the Tribe Sticholotidini. New records are *Bulaea lichatschovii* (Hummel), *Exochomus pubescens* Küster, *Scymnus (Pullus) latemaculatus* Motschulsky, *Scymnus (Pullus) syriacus* Marseul with four varieties of *Cheilomenes sexmaculatus* (Fabricius).

Subfamily Coccinellinae Latreille, 1807

Tribe Coccinellini Latreille, 1807

Coccinella Linnaeus, 1758

Coccinella septempunctata Linnaeus, 1758

Fig. 1

General distribution. India, Nepal, Sri Lanka, Pakistan, Palaearctic. North America (Poorani 2002).

Distribution in Sindh. Tandojam, Larkana, Mirpur Khas, Thatta, Karachi (Sarwar 2009, Mahmood et al. 2011, Ali 2013, Fazal Ellahi et al. 2017).

Host plants and prey species in Sindh. *Brevicoryne brassicae* (L), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera); *Amrasca devastans* (Dist), *Amrasca biguttula biguttula* (Ishida) (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, sugarcane, and rose plants (Ali 2013).

Coccinella undecimpunctata Linnaeus, 1758

Fig. 2

General distribution. India, Pakistan. Palaearctic (Poorani 2002).

Distribution in Sindh. Karachi, Hyderabad, Tandojam, Mirpur Khas and Thatta (Sarwar 2009, Mahmood et al. 2011, Ali 2013, Fazal Ellahi et al. 2017).

Host plants and prey species in Sindh. *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera); *Amrasca devastans* (Dist), *Amrasca biguttula biguttula* (Ishida) (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, brinjal, okra, wheat, cotton, sugarcane, and rose plants (Ali 2013).



Figure 1. *Coccinella septempunctata* Linnaeus.



Figure 2. *Coccinella undecimpunctata* Linnaeus.

***Coccinella transversalis* Fabricius, 1781**

Fig. 3

General distribution. India, Nepal, Sri Lanka, Bangladesh, Indochina, Indonesia, Japan, Australia, New Zealand (Poorani 2002).

Distribution in Sindh. Hyderabad, Larkana, Mirpur Khas, and Thatta (Ali 2013).

Host plants and prey species in Sindh. *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteronoeura setariae* (Thomas), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera); *Amrasca devastans* (Dist), *Amrasca biguttula biguttula* (Ishida) (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, brinjal, okra, wheat, cotton, sugarcane, and rose plants (Ali 2013).



Figure 3. *Coccinella transversalis* Fabricius.

***Cheilomenes* Dejean, 1836**

***Cheilomenes sexmaculata* (Fabricius, 1781)**

Fig. 4

General distribution. India, Bangladesh, Pakistan, Sri Lanka, Bhutan, Myanmar, Malaysia, Indonesia, Philippines, Vietnam, China, Japan, Australia (Poorani 2002).

Distribution in Sindh. Hyderabad, Larkana, Mirpur Khas, and Thatta (Sarwar 2009, Mahmood et al. 2011, Ali 2013, Balouchi and Swati 2014, Fazal Ellahi et al. 2017).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Schizaphis graminum* (Rondani), *Ropalosiphum maidis* (Fitch), *Therioaphis trifolii* Monell (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll), *Centrococcus insolitus* Green (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera) *Aleurocanthus husaini* Corbett, *Aleurocanthus woglumi* Ashby, *Aleurolobus barodensis* Mask *Amrasca devastans* (Dist), *Amrasca biguttula* *biguttula* (Ishida), *Amritodus atkinsoni* Leth, *Evacanthus repexus* Dist (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera), *Pyrilla perpusilla* Walk (Fulgoridae: Homoptera), *Quadrastriiotus perniciosus* Comst (Diaspididae: Homoptera), *Diaphorina citri* Kuw (Psyllidae: Homoptera), *Tetranychus orientalis* Mog (Acarina: Tetranychidae) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).

Comment. Common. It is very difficult to compare this species with other taxa because of polymorphism. Six varieties of this species are reported from Pakistan.



Figure 4. *Cheilomenes sexmaculata* (Fabricius).

***Hippodamia variegata* (Goeze, 1777)**

Fig. 5

General distribution. Nepal, Pakistan, Afghanistan, Tibet, Mongolia, China, northern and eastern Africa, Palaearctic (Poorani 2002).

Distribution in Sindh. Hyderabad, Karachi, and Thatta (Lohar et al. 2012, Ali 2013).

Host plants and prey species in Sindh. *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera); *Amrasca devastans* (Dist), *Amrasca biguttula biguttula* (Ishida) (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, brinjal, okra, wheat, cotton, and rose plants (Ali 2013).



Figure 5. *Hippodamia variegata* (Goeze).

***Micraspis allardi* (Mulsant, 1866)**

Fig. 6

General distribution. India, Nepal, Pakistan, Myanmar, Indonesia (Poorani 2002).

Distribution in Sindh. Hyderabad, Mirpur Khas, Thatta and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Amritodus atkinsoni* Teth (Cicadellidae: Homoptera) *Quadraspidiotus perniciosus* Comst (Diaspididae: Homoptera), *Pyrilla perpusilla* Walk (Fulgoridae: Homoptera) (Ali 2013).

***Oenopia sauzeti* Mulsant, 1866**

Fig. 7

General distribution. India, Bhutan, Pakistan, Nepal, Myanmar, Thailand, China (Poorani 2002).

Distribution in Sindh. Hyderabad, Mirpur Khas, Thatta, and Karachi (Ali 2013).

Host plants and Prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Schizaphis graminum* (Rondani), *Ropalosiphum maidis* (Fitch) (Aphididae: Homoptera), *Aleurolobus barodensis* Mask *Amrasca devastans* (Dist), *Amrasca biguttula biguttula* (Ishida), *Evacanthus repexus* Dist (Cicadellidae: Homoptera), *Tetranychus* sp. (Acarina: Tetranychidae) on wheat, mustard, and cabbage (Ali 2013).

***Propylea quatuordecimpunctata* (Linnaeus, 1758)**

Fig. 8

General distribution. India, Pakistan, Bangladesh, Japan, China, Europe, North America (Poorani 2002).



Figure 6. *Micraspis allardi* (Mulsant).



Figure 7. *Oenopia mimica* Weise.



Figure 8. *Propylea quatuordecimpunctata* (Linnaeus).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis*

gossypii (Glover), *Hyadaphis coriandri* (Das) (Aphididae: Homoptera), *Aleurolobus barodensis* Mask *Amrasca devastans* (Dist), *Amrasca biguttula biguttula* (Ishida), *Evacanthus repexus* Dist (Cicadellidae: Homoptera) (Ali 2013).

***Harmonia dimidiata* (Fabricius, 1781)**

Fig. 9

General distribution. India, Pakistan, Nepal, Bhutan, China, Japan, Taiwan, introduced into North America (Poorani 2002).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae*(L), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Ropalosiphum maidis* (Fitch), *Therioaphis trifolii* Monell, *Macrosiphum granarium* (Kirby), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera), *Amritodus atkinsoni* Leth, *Idioscopus nagpurensis* Pruthi (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera), *Tetranychus atlanticus* Mog (Acarina: Tetranychidae), *Adelges* spp. (Adelgidae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).

Tribe Bulaeini Savoiskaja, 1969

***Bulaea lichatschovii* (Hummel, 1827)**

Fig. 10

General distribution. Pakistan, India, Central and West Asia, Afghanistan, Mediterranean region. North and Central Africa (Poorani 2002, Ali 2013).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Myzus persicae* (Sulzer), *Diaphorina citri* Kuw (Psyllidae: Homoptera) on wheat and mustard.

Comments. Newly recorded from Pakistan.

Tribe Psylloborini Casey, 1899

***Psyllobora bisoconotata* (Mulsant, 1850)**

Fig. 11

General distribution. India and Pakistan (Poorani 2002).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Prey in Sindh. All the members of this genus are mycophagous (Ali 2013).



Figure 9. *Harmonia dimidiata* (Fabricius).



Figure 10. *Bulaea lichatschovii* (Hummel).



Figure 11. *Psyllobora bisoconotata* (Mulsant).

Tribe Chilocorini Costa, 1849***Chilocorus* Leach, 1815b*****Chilocorus nigrita* (Fabricius, 1798)**

Fig. 12

General distribution. Agalega, American Samoa, Burma, Brazil, Ghana, Guam, Hawaii, India, Indonesia, Kenya, Madagascar, Malaysia, Marshall Islands, New Caledonia, Nepal, Oman, Pakistan, Reunion Island, Seychelles, Solomon Islands, South Africa, Swaziland, Society Islands, Tanzania, Togo, Turkey and Zimbabwe (Nandwani and Joseph 2003, NBAII 2011, Omkar and Pervez 2003, Poorani 2002, Thomas and Blanchard 2014).

Distribution in Sindh. Tandojam, Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aonidiella auranti* (Mask), *A. citrina* (Coq), *A. orientalis* Newst, *Aspidiotus destructor* Sign, *Hemiberlesia latanias* (Sign), *Leucaspis coniferarum* Hall & Williams, *Parlatoria* spp, *Pinnaspis strachani* (Cooley), *Quadraspidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera) (Ali 2013).

***Exochomus (Parexochomus) nigripennis* Erichson, 1843**

Fig. 13

General distribution. northwestern India, Pakistan, Palaearctic, Africa (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali, 2013).

Host plants and prey species in Sindh. *Aphis fabae* Theobald, *Rhopalosiphum maidis* Fitch (Aphididae: Homoptera), *Parlatoria* spp. (Diaspididae: Homoptera), *Ferisia virigata* (Ckll) (Pseudococcidae: Homoptera). It was recorded on trees and wild plants (Ali 2013).

***Exochomus pubescens* Küster, 1848**

Fig. 14

General distribution. Pakistan, India, Spain, North Africa, Greece, Egypt, Syria, Palestine (Poorani 2002).

Distribution in Sindh. Karachi (Ali 2013).

Host plants and prey species in Sindh. *Parlatoria* spp. (Diaspididae: Homoptera). It was found on oak (Ali 2013).

Comment. Newly recorded from Pakistan.



Figure 12. *Chilocorus nigrita* (Fabricius).



Figure 13. *Exochomus nigripennis* (Erichson).

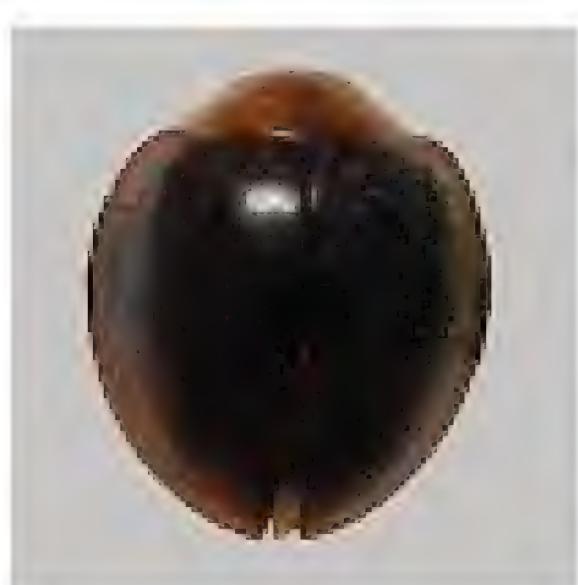


Figure 14. *Exochomus pubescens* Küster.

***Priscibrumus uropygialis* (Mulsant, 1853)**

Fig. 15

General distribution. India, Bhutan, Pakistan, Nepal (Poorani 2002).**Distribution in Sindh.** Tandojam and Hyderabad (Ali 2013).**Host plants and prey species in Sindh.** *Parlatoria* spp., *Pinnaspis strachani* (Cooley), *Quadrasipidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera) on wild trees, and shrubs (Ali 2103).***Brumoides suturalis* (Fabricius, 1798)**

Fig. 16

General distribution. India, Pakistan, Bangladesh, Sri Lanka, Bhutan, Nepal (Poorani 2002).**Distribution in Sindh.** Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali 2013).**Host plants and prey species in Sindh.** *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Ropalosiphum maidis* (Fitch), *Therioaphis trifolii* Monell, *Macrosiphum granarium* (Kby), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera), *Amrasca devastans* (Dist), *Amrasca biguttula* *biguttula* (Ishida) (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera), *Tetranychus atlanticus* Mog (Acarina: Tetranychidae), *Adelges joshii* S.O & S (Adelgidae: Homoptera), *Aonidiella auranti* (Mask), *A. citrina* (Coq), *A. orientalis* Newst, *Aspidiota destructor* Sign, *Hemiberlesia latanias* (Sign), *Leucaspis coniferarum* Hall & Williams, *Parlatoria* spp, *Pinnaspis strachani* (Cooley), *Quadrasipidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).**Tribe Noviini Mulsant, 1850, Genus *Rodolia* Mulsant, 1850*****Rodolia ruficollis* Mulsant, 1850**

Fig. 17

General distribution. India, Pakistan, Thailand (Poorani 2002).**Distribution in Sindh.** Karachi and Mirpur Khas (Ali 2013).**Host plants and prey species in Sindh.** *Icerya aegyptiaca* (Dougl) (Margarodidae: Homoptera). It was found on cotton and roses (Ali 2013).



Figure 15. *Priscibrumus uropygialis* (Mulsant).



Figure 16. *Brumoides suturalis* (Fabricius).

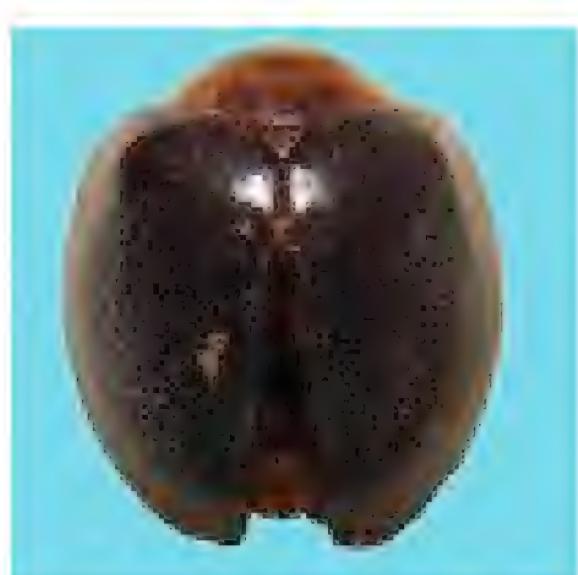


Figure 17. *Rodolia ruficollis* Mulsant.

Tribe Hyperaspini Costa, 1849, Genus *Hyperaspis* Chevrolat, 1836

Hyperaspis maindroni Sicard, 1929

Fig. 18

General distribution. Pakistan and India (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Centrococcus insolitus* (Green), *Naiacoccus* sp, *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera). It was found on cotton, okra, and trees (Ali 2013).

Tribe Stethorini Dobzhansky, 1924, Genus *Stethorus* Weise, 1885b

Stethorus gilvifrons (Mulsant, 1850)

Fig. 19

General distribution. India, Pakistan, Italy, Cyprus (Poorani 2002).

Distribution in Sindh. Tandojam, Hyderabad, Mirpur Khas and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Brevipalpus* sp. (Tenuipalpidae: Acarina), *Eutetranychus cernus* (B&P), *E. orientalis* (Klein), *Tetranychus atlanticus* Mog (Acarina: Tetranychidae). It was collected from eggplant, okra, and some wild plants (Ali 2013).

Tribe Scymnini Mulsant, 1846, Genus *Scymnus*, Mulsant, 1850

Scymnus (Scymnus) nubilus Mulsant, 1850

Fig. 20

General distribution. Pakistan, India, Bangladesh, Sri Lanka, Nepal, Myanmar, China, Asia Minor (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Ropalosiphum maidis* (Fitch), *Therioaphis trifolii* Monell, *Macrosiphum granarium* (Kby), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera), *Amrasca devastans* (Dist), *Amrasca biguttula biguttula* (Ishida) (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera), *Tetranychus atlanticus* Mog (Acarina: Tetranychidae), *Adelges joshii* S.O



Figure 18. *Hyperaspis maindroni* Sicard.



Figure 19. *Stethorus gilvifrons* (Mulsant).



Figure 20. *Scymnus (Scymnus) nubilus* Mulsant.

& S (Adelgidae: Homoptera), *Aonidiella auranti* (Mask), *A. citrina* (Coq), *A. orientalis* Newst, *Aspidiottus destructor* Sign, *Hemiberlesia latanias* (Sign), *Leucaspis coniferarum* Hall & Williams, *Parlatoria* spp, *Pinnaspis strachani* (Cooley), *Quadraspidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton and rose plants (Ali 2013).

***Scymnus (Pullus) latemaculatus* Motschulsky, 1858**

Fig. 21

General distribution. Pakistan, India, Bangladesh, Sri Lanka, Thailand, Taiwan. (Poorani 2002; Ali 2013).

Distribution in Sindh. Tandojam, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Ropalosiphum maidis* (Fitch), *Theroaphis trifolii* Monell, *Macrosiphum granarium* (Kby), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera), *Amrasca devastans* (Dist), *Amrasca biguttula* (Ishida) (Cicadellidae: Homoptera); *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera), *Tetranychus atlanticus* Mog (Acarina: Tetranychidae) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).

Comment. Newly recorded from Pakistan.

***Scymnus (Pullus) coccivora* Ayyar, 1925**

Fig. 22

General distribution. India, Pakistan, Bangladesh, Sri Lanka, Malaysia (Poorani 2002).

Distribution in Sindh. Tandojam, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Ropalosiphum maidis* (Fitch), *Theroaphis trifolii* Monell, *Macrosiphum granarium* (Kby), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera), *Tetranychus atlanticus* Mog (Acarina: Tetranychidae) on mustard, lucern, cabbage, cauliflower, potato, turnip, bottle gourd, eggplant, okra, wheat, cotton, and rose plants (Ali 2013).



Figure 21. *Scymnus (Pullus) latemaculatus* Motschulsky.



Figure 22. *Scymnus (Pullus) coccivora* Ayyar.

***Scymnus (Pullus) castaneus* Sicard, 1929**

Fig. 23

General distribution. Pakistan, India, Bangladesh (Poorani 2002).

Distribution in Sindh. Tandojam, Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Ropalosiphum maidis* (Fitch), *Therioaphis trifolii* Monell, *Macrosiphum granarium* (Kby), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green). It was found on eggplant, okra, cotton (Ali 2013).

Comment. Newly recorded from Pakistan.



Figure 23. *Scymnus (Pullus) castaneus* Sicard.

***Scymnus (Pullus) syriacus* (Marseul, 1868)**

Fig. 24

General distribution. Iran, Afghanistan, Pakistan (Ali 2013).

Distribution in Sindh. Hyderabad and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aphis craccivora* Koch, *A. gossypii* Glover, *Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Hysteroneura setariae* (Thomas), *Ropalosiphum maidis* (Fitch), *Theroaphis trifolii* Monell, *Macrosiphum granarium* (Kby), *Schizaphis graminum* (Rondani) (Aphididae: Homoptera) (Ali 2013).

Comment. Newly recorded from Pakistan.

***Nephus regularis* (Sicard, 1929)**

Fig. 25

General distribution. India, Pakistan, China (Poorani 2002).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad and Karachi (Ali 2013).

Prey and host plant. *Aphis craccivora* Koch, *A. gossypii* Glover, *Aphis gossypii* (Glover), *Hyadaphis coriandri* (Das), *Theroaphis trifolii* Monell (Aphididae: Homoptera); *Phenacoccus solenopsis* (Tinsley), *Ferrisia virigata* (Ckll) (Pseudococcidae: Homoptera), *Drosicha mangiferae* (Green) (Margarodidae: Homoptera) on eggplant, okra and cotton (Ali 2013).

Tribe Shirozuellini Sasaji, 1967, Genus *Ghanius* Ahmad, 1973

***Ghanius karachiensis* Ahmad, 1973**

Fig. 26

General distribution. Pakistan (Poorani 2002).

Distribution in Sindh. Karachi (Ali 2013).



Figure 24. *Scymnus (Pullus) syriacus* (Marseul).



Figure 25. *Nephus regularis* (Sicard).



Figure 26. *Ghanius karachiensis* Ahmad.

Host plants and prey species in Sindh. *Aonidiella auranti* (Mask), *A. citrina* (Coq), *A. orientalis* Newst, *Hemiberlesia latanias* (Sign), *Leucaspis coniferarum* Hall & Williams, *Parlatoria* spp. *Pinnaspis strachani* (Cooley), *Quadraspidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera) (Ali 2013).

Tribe Sticholotidini Weise, 1901***Pharoscymnus flexibilis* (Mulsant), 1853**

Fig. 27

General distribution. India, Pakistan, Brazil, and United States (Florida) (Poorani 2002, Thomas and Blanchard 2013).

Distribution in Sindh. Tandojam, Mirpur Khas, Hyderabad, and Karachi (Ali 2013).

Host plants and prey species in Sindh. *Aspidiotus destructor* Sign, *Hemiberlesia latanias* (Sign), *Leucaspis coniferarum* Hall & Williams, *Parlatoria* spp, *Pinnaspis strachani* (Cooley), *Quadraspidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera), *Coccus hesperidium* L, *Siassetia nigra* (Nietn) (Coccidae: Homoptera) on wheat and mustard (Ali 2013).

***Pharoscymnus simmondsi* Ahmad, 1970**

Fig. 28

General distribution. Pakistan, Thailand (Poorani 2002).

Distribution in Sindh. Karachi (Ali 2013).

Host plants and prey species in Sindh. *Parlatoria* spp., *Pinnaspis strachani* (Cooley), *Quadraspidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera), *Coccus hesperidium* L, *Siassetia nigra* (Nietn) (Coccidae: Homoptera) on wheat and mustard (Ali 2013).

***Pharoscymnus horni* (Weise), 1900**

Fig. 29

General distribution. India and Pakistan (Poorani 2002).

Distribution in Sindh. Karachi (Ali 2013).

Host plants and prey species in Sindh. *Parlatoria* spp. *Pinnaspis strachani* (Cooley), *Quadraspidiotus perniciosus* Comst, *Tecaspis* spp. (Diaspididae: Homoptera), *Coccus hesperidium* L, *Siassetia nigra* (Nietn) (Coccidae: Homoptera) on mustard and wheat (Ali 2013).

Discussion

Unfortunately, all the specimens were lost during the shifting of Vitoria Museum to National Museum at Karachi. From Pakistan very little taxonomic work has focussed especially on this important family of the order Coleoptera. Irshad (2001) listed 71 species of coccinellids from northern parts of Pakistan. Rafi et al. (2005) listed 37



Figure 27. *Pharoscymnus flexibilis* (Mulsant).



Figure 28. *Pharoscymnus simmondsi* Ahmad.



Figure 29. *Pharoscymnus horni* (Weise).

genera and 75 species and described the only external morphology of predatory coccinellids mostly collected from northern parts of Pakistan with special reference with their hosts, prey, and localities.

Sindh Province has a rich insect fauna which have diversified into important cities like Karachi, Tandojam, Hyderabad, Larkana, Sukkur, and Mirpur Khas. Coccinellids fauna is still incompletely recorded from Sindh region and has been neglected in the past. All the research findings on coccinellids except Ali (2013) were documentary not taxonomic. No proper collections, identification procedures, or techniques have been used in Sindh to explore the hidden records of insects, including the coccinellid fauna. Ali (2013) worked more comprehensively on the systematics and distribution of ladybirds of Sindh Province with reference to their role in biological control programmes. He tried to highlight the importance of systematic study to make easy their identification as predators of mealybugs, aphids, jassids, whiteflies, and scale insects. This research work may be useful for the entomologists including research students of particularly the Sindh region, but also of Pakistan and other Oriental regions. The geographical distribution and synonyms used in this study for all systematically treated specimens were cited from the findings of Hashmi and Tashfeen (1992).

The present investigation continues the research carried by Ali (2013), and gives a preliminary checklist of ladybirds from Sindh consisting of only one subfamily, ten tribes, 21 genera, and 29 species including four new records: *Bulaea lichatschovii* (Hummel), *Exochomus pubescens* Küster, *Scymnus (Pullus) latemaculatus* Motschulsky, *Scymnus (Pullus) syriacus* Marseul and four varieties of *Menochilus sexmaculata* (Fabricius). All these coccinellids from Pakistan are now placed into the subfamily Coccinellinae and the subfamily Microweiseinae according to the recent classification studies. The coccinellid specimens were deposited in the Natural History Museum, Department of Zoology, University of Karachi, Karachi, Pakistan.

Acknowledgements

The authors would like to express their heartfelt gratitude to Dr. Rukhsana Perveen, who provided guidance, necessary facilities, and took a keen interest throughout the progress of the present research. We would like to extend our deep gratitude and sincere thanks to Dr. Claudio Canepari, an authority on the family Coccinellidae, who spent his valuable time assisting us in identification, confirmation, and guidance. We are grateful to Dr. Louis Hesler, Lead Scientist & Research Entomologist, USDA-ARS, North Central Agricultural Research Laboratory (NCARL), U.S.A, for his review and English proofing of this paper.

References

Abbas G, Arif MJ, Saeed S, Karar H (2007) Increasing Menace of a New Mealybug *Phenacoccus gossypiphilous* to the Economic Crops of Southern Asia. In: Abstract XI Int. Symposium on Scale Insect Studies (ISSIS), Oeiras, 30 pp.

Abbas, MN, Kausar S, Rana NA (2013) Diversity and Distribution of Ladybird beetles (Coccinellidae) in the Cropland of Faisalabad District. International Journal of Advanced Research 1: 27–33.

Ahmad R, Ghani MA (1966) A new genus and species of Chilocorini (Coleoptera: Coccinellidae) from Pakistan. Proceedings of the Royal Entomological Society of London (B) 35: 9–10. <https://doi.org/10.1111/j.1365-3113.1966.tb00459.x>

Ahmad R (1969) Studies on Coccoidea and their natural enemies in West Pakistan. PhD Thesis, University of Punjab, Pakistan.

Ahmad R (1968) A new species of *Pseudoscyrnus* Chapin (Col., Coccinellidae) predaceous on scale insects in West Pakistan. Entomophaga 13: 377–379. <https://doi.org/10.1007/BF02371920>

Ahmad R (1970) A new species of *Pharoscymnus* Bedel (Coleoptera: Coccinellidae) predaceous on scale insects in Pakistan. Entomophaga 15: 233–235. <https://doi.org/10.1007/BF02371001>

Ahmad R (1973) A new tribe of the family Coccinellidae (Coleoptera). Bulletin of Entomological Research 62: 449–452. <https://doi.org/10.1017/S0007485300003989>

Ali M, Perveen R, Siddique NY, Hussain R (2012) Redescription of three species of the genus *Coccinella* (Coccinellidae: Coleoptera) from Sindh, Pakistan. Pakistan Entomologist 34: 167–171.

Ali M, Perveen R, Yusouf MJ, Khawaja S, Amin M (2014) Predatory potential of five coccinellids against cotton mealy bug *Phenacoccus solenopsis* (Tinsley) from Sindh, Pakistan. Pakistan Entomologist 36: 7–12.

Ali M, Naqvi AN, Perveen R, Ahmad K, Hussain I (2014) First Record of the Tribe Bulaeini (Coleoptera: Coccinellidae) With Generic and Species Descriptions from Pakistan. Pakistan Journal of Zoology 46: 1475–1478.

Ali M, Perveen R, Naqvi AN, Ahmed K, Raza G, Hussain I (2015) The Tribe Scymnini (Coccinellidae: Coleoptera) From Sindh Province, Pakistan. Journal of Insect Science 15: 146. <https://doi.org/10.1093/jisesa/iev105>

Ali N, Munir M (1984) Production technology of rape and mustard in Pakistan. In: Manual of rapeseed and mustard production technology. In: Beg NA, Munir M (Eds) Pakistan Agricultural Research Council Islamabad. Pakistan, 33–46.

Arif MI, Rafiq M, Ghaffar A (2009) Host plants of cotton mealybug (*Phenacoccus solenopsis*): a new menace to cotton agroecosystem of Punjab, Pakistan. International Journal of Agriculture and Biology 11: 163–167.

Ashfaque M, Ullah F, Rafi MA (2013) Genus *Coccinella* (Coccinellidae: Coleoptera) from Gilgit-Baltistan with two new records from Pakistan. Sarhad Journal of Agriculture 29: 240–247.

Aslam M, Razaq M, Shah SA, Ahmad A (2004) Comparative efficacy of different insecticides against sucking pests of cotton. Journal of research Science 15: 53–58.

Buriro AH, Hameed S, Afzidi K, Qazi JK, Mahar AN (2006) Population Dynamics of Grain Aphid, *Sitobion avenae* F. (Aphididae: Homoptera) and Barley Thrips, *Limothrips cerealium* H. (Thripidae: Thysanoptera) on Wheat and Barley in Highland Balochistan. Pakistan Journal of Zoology 38: 191–196.

Canepari C (2011) Fauna Europaea: Coccinellidae. In: Audisio P (Ed.) Fauna Europea: Coleoptera, Lady-birds. Fauna Europaea, version 2.3, <http://www.faunaeur.org> [Accessed: 12.1.2012]

Canepari C, Gordon RD, Hanley GA (2016). South American Coccinellidae (Coleoptera), Part XVII: Systematic revision of the genera *Cyrea* Gordon and Canepari and *Tiphysa* Mulsant (Hyperaspidinae: Brachiacanthini). *Insecta Mundi* 0486: 1–180. <http://digitalcommons.unl.edu/insectamundi/991>

Gordon RD (1985) The Coccinellidae of America north of Mexico. *Journal of the New York Entomological Society* 93: 1–912.

Ghani MA (1985) Aleyrodids attacking citrus in Pakistan and their control. *Journal of Agricultural Research* 23: 289–318.

Ghouri ASK (1960) Insect Pests of Pakistan. FAO Technical Bulletin No. 8, FAO Regional Office for Asia and the Far East, Bangkok, 30 pp.

Hashmi AA, Hussain M M, Ulfat M (1983) Insect pest complex of wheat crop. *Pakistan Journal of Zoology* 15: 169–76.

Hashmi AA, Tashfeen A (1992) Coleoptera of Pakistan. *Proceeding of Pakistan Congress of Zoology* 12: 133–170.

Hodek I (2012) Diapause/Dormancy. In: Hodek I, van Emden HF, Honěk A (Eds) *Ecology and Behaviour of the Ladybird Beetles (Coccinellidae)*. Blackwell Publishing Ltd., Chichester, 275–342. <https://doi.org/10.1002/9781118223208.ch6>

Iablokoff-Khnzorian SM (1986) *Adalia puetzi* n. sp., nouvelle espece du Pakistan (Col. Coccinellidae). *Nouvelle Revue d'Entomologie* 3: 80.

Inayatullah C, Siddiqui EM (1978) Comparative studies on the anatomy of the abdomen of *Coccinella septumpunctata* and *Coccinella undecimpunctata* (Coleoptera: Coccinellidae). *Pakistan Journal of Zoology* 10: 261–271.

Inayatullah C, Siddiqui EM (1979) Comparative skeletal anatomy of the head capsule of *Coccinella septumpunctata* and *Coccinella undecimpunctata* (Coleoptera: Coccinellidae). *Pakistan Journal of Zoology* 11: 85–97.

Inayatullah C (1980) Comparative skeletal anatomy of the thorax of *Coccinella septumpunctata* and *Coccinella undecimpunctata* (Coleoptera: Coccinellidae). *Pakistan Journal of Zoology* 12: 225–237.

Inayatullah C (1984) Sugar-cane aleurodids, *Aleurolobus barodensis* (Maskell) and *Neomaskellia andropogonis* Corbett (Hom: Aleyrodidae), and their natural enemies in Pakistan. *International Journal of Tropical Insect Science* 5: 279–282. <https://doi.org/10.1017/S1742758400001570>

Iperti G, Bertand E (2001) Hibernation of *Harmonia axyridis* (Coleoptera: Coccinellidae) in South-Eastern France. *Acta Societas Zoologicae Bohemicae* 65: 207–210.

Irshad M (2001a) Aphids and their biological control in Pakistan. *Pakistan Journal of Biological Sciences* 4: 537–541. <https://doi.org/10.3923/pjbs.2001.537.541>

Irshad M (2001) Distribution, hosts, ecology and biotic potentials of coccinellids of Pakistan. *Pakistan Journal of Biological Sciences* 4: 1259–1263. <https://doi.org/10.3923/pjbs.2001.1259.1263>

Irshad M (2003) Parasitoids, predators and pathogens of agricultural and forest pests of Pakistan. National IPM Programme, National Agricultural Research Centre, Islamabad, 78 pp.

Irshad M, Khan MR (2005) Insect pests of plants and their parasitoids, predators and pathogens in Pakistan. PIPS Ltd., Islamabad, 72 pp.

Iqbal J, Ashfaq M, Ali A (2008) Management of aphids by augmentation of coccinellids and *Chrysoperla carnea* under field conditions on wheat. Pakistan Journal of Agricultural Sciences 45: 57–59.

Iqbal J, Hassan MU, Ashfaq M, Sahi ST, Ali A (2008) Screening of okra genotypes against jassid, *Amrasca biguttula biguttula* (Ishida) (Homoptera: Cicadellidae). Pakistan Journal of Agricultural Sciences 45: 448–451.

Kazmi SK (1980) *Eutetranychus orientalis* (Klein) (Acarina: Tetranychidae) and its predators in Pakistan. 1st Proceeding of Pakistan Congress of Zoology, 313–318.

Khan I, Din S, Khalil SK, Rafi MA (2006) Survey of predatory coccinellids (Coleoptera: Coccinellidae) in the Chitral District, Pakistan. Journal of Insect Science 7: 7–10.

Khan MGR, Inayatullah M, Rafi MA, Ashfaque A (1999a) Species composition, distribution and host plants of predatory coccinellids (Coccinellidae: Coleoptera) in District Bagh, Azad Jammu and Kashmir. Pakistan Journal of Entomology Karachi 14: 1–4.

Khan MR, Sheikh MK, Rafi MA, Sharif A (1999b) Predatory coccinellid Fauna (Coleoptera: Coccinellidae) of Sudhnuti District, Azad Jammu Kashmir. Pakistan Journal Entomology Karachi 14: 5–7.

Majerus MEN (1994) Ladybirds. Harper Collins, London, 367 pp.

Mari JM, Lohar, MK (2010) Pests and predators recorded in Brassica Ecosystem. Pakistan Journal of Agricultural and Veterinary Sciences 26: 58–65.

Masood N (2011) Spatio-temporal Trends And Integrated Management Of Sugarcane Whitefly, *Aleurolobus barodensis* (mask.), (Aleyrodidae: Homoptera). PhD Thesis, University Of Agriculture, Faisalabad.

Masood N, Ali A, Ahsan M, Javed N (2011) Whitefly (*Aleurolobus barodensis* Mask.) population fluctuation in diverse spatio-temporal conditions on sugarcane crop native to Pakistan. International Research Journal of Plant Science 2: 179–185.

Michels GJ (1987) A checklist of the Coccinellidae (Coleoptera) of Wyoming. The Coleopterist Bulletin 41: 249–255.

Mohyuddin AI (1981) A Review of Biological Control in Pakistan. Proc. 2nd Pakistan Cong. Zool, 31–79.

NBAII (2009) Factsheets on Agriculturally Important Insects. <http://www.nbaii.res.in/Featured%20insects/featured-insects.html>

Obrycki JJ, Kring TJ (1998) Predaceous Coccinellidae in biological control. Annual Review of Entomology 43: 295–321. <https://doi.org/10.1146/annurev.ento.43.1.295>

Perveen F, Khan A, Habib A (2014) Comparative characterization of ladybird beetles (Coleoptera: Coccinellidae) from Hazara University, Garden Campus, Mansehra, Pakistan. Advances in Entomology 2: 61–68. <https://doi.org/10.4236/ae.2014.22011>

Poorani J (2004) An annotated checklist of the Coccinellidae (Coleoptera) (excluding Epilachninae) of the Indian subregion. Oriental Insects 36: 307–383. <https://doi.org/10.1080/00305316.2002.10417335>

Rafi MA, Irshad M, Inayatullah M (2005) Predatory ladybird beetles of Pakistan. National Insect Museum & Insect Pest Informatics, IPM Programme.

Rafiq M, Ghaffar A, Arshad M (2008) Population Dynamics of Whitefly (*Bemisia tabaci*) on Cultivated Crop Hosts and their Role in Regulating its Carry-over to Cotton. International Journal of Agricultural Biology 10: 200–212.

Rahatullah H, Ahmad, Inayatullah M (2010) Diversity of Coccinellidae from Dir valley. M. Phil. thesis. Department of Zoology, Hazara University, Mansehra.

Rahatullah H, Mehmood HM, Saeed K, Rehman S (2011) Diversity and distribution of ladybird beetles in District Dir Lower, Pakistan. International Journal of Biodiversity and Conservation 3: 670–675.

Rahatullah H, Ahmed H, Inayatullah M, Saeed K, Khan S (2012) Morphological characteristics of ladybird beetles collected from District Dir Lower, Pakistan. African Journal of Biotechnology. 11: 9149–9155.

Rahman KA (1940) Rahman, K. A. 1940. Important insect predators of India. Proceeding of India Academy of Science (B) 12: 67–74.

Robertson JA, Slipinski A, Moulton M, Shockley FW, Giorgi A, Lord NP, Mckenna DD, Tomaszevska W, Forrestor JI, Miller KB, Whitting MF, Hugh JM (2015) Phylogeny and classification of Cucujoidea and the recognition of a new superfamily Coccinelloidea (Coleoptera: Cucujiformia). Systematic Entomology. <https://doi.org/10.1111/syen.12138>

Seago AE, Giorgi JA, Li J, Slipinski A (2011) A Phylogeny, classification and evolution of ladybird beetles (Coleoptera: Coccinellidae) based on simultaneous analysis of molecular and morphological data. Molecular Phylogenetics and Evolution 60(1): 137–51. <https://doi.org/10.1016/j.ympev.2011.03.015>

Shah MZ (1983) The Ladybird beetles (Coccinellidae: Coleoptera) of Peshawar region. M. Sc Thesis, Department of Entomology, N.W.F.P. Agricultural University Peshawar, Pakistan.

Slipinski A (2007) Australian Ladybird Beetles (Coleoptera: Coccinellidae). Dept. of the Environment and Water Resources, Canberra, 286 pp.

Solangi BK, Lanjar AG, Lohar MK (2007) Biology of 11 – spotted Beetle *Coccinella undecimpunctata* L. (Coccinellidae: Coleoptera) on Mustard Aphid *Lipaphis erysimi* Kalt. Journal of Applied Sciences 7: 3086–3090. <https://doi.org/10.3923/jas.2007.3086.3090>

Solangi BK, Hullio MH, Baloch N (2007) Biological parameters and prey consumption by zig-zag beetle, *Menochilus sexmaculatus* Fab against *Rhopalosiphum maidis* Fitch, *Aphis gossypii* Glover and *Therioaphis trifolii* Monell. Sarhad Journal of Agriculture 23(4): 1097–1101.

Zahoor MK, Suhail A, Iqbal J, Zulfaqar Z, Anwar Z (2003) Biodiversity of Predaceous coccinellids and Their role as Bioindicators in an Agro- ecosystem. International Journal of Agriculture and Biology 5: 555–559.